charts. The relative frequency (expressed in percentages) of the eight principal wind directions for the months April to October is shown by wind roses. The period of observation is the twenty years 1876-1895. The data are those recorded on board of vessels reporting to the Danish Meteorological Institute. In addition to the observations made at sea, wind roses are given for several coast stations. The mean wind directions, indicated by single arrows, are also shown on inset isobaric charts (reduced from Rung's larger charts). The text is both Danish and English. The information so clearly presented in this publication will prove very useful to those who are studying the wind movements over this somewhat neglected area, where, owing to the presence of the "Iceland Low," the wind circulation has a peculiar interest.

R. DEC. WARD.

The Waters of the Northeastern North Atlantic. Investigations made during the cruise of the *Frithjof*, of the Norwegian Royal Navy, in July 1910. By Fridtjof Nansen. 139 pp. Maps. Dr. W. Klinkhardt, Leipzig, 1913. 9½ x 6½.

A great stream, 1500 meters deep, travels along the eastern border of the North Atlantic all the way from the Spanish and African coasts, close under the continental slopes. A little surface water is blown upon it from the North Atlantic Drift, but an insignificant amount. The main mass has never been across the Atlantic and is driven north by differences of density due to temperature.

Most interesting is the method of study. Nansen has examined the temperature, salinity and density of the water at all depths on sections that have been made *across the current*. A stream deflected to the right by the earth's rotation must have its surface waters *thicker* on the right, i. e., the lines of equal density parting light surface water from heavier underwater, must descend across the current *to the right*. As this does happen *to the east* on all sections, the water is moving north. Confirmatory is Mediterranean water at 800 to 2000 meters all the way from Gibraltar to Ireland, recognizable by its warmth, though it is so heavy with salt it lies under the colder Atlantic water.

MARK JEFFERSON.

Meteorological Charts of the Southern Ocean between the Cape of Good Hope and New Zealand. 2nd edit. 10 pp. 36 charts. Meteorological Committee Offic. Copy No. 123. London, 1907. 6s. 9½ x 13.

The first edition of these excellent charts was issued in 1899. The observations used were from a large number of logs (all that were available) of British naval and merchant vessels for the period 1855-1895. The area covered is Lat. 30°-60° S. and Long. 10°-180° E. The charts show, for each month of the year, the wind direction and force, pressure, air and sea surface temperatures, fog, and ocean currents. The second edition was published in 1907. The scale of the wind, pressure, air and sea surface temperatures and fog charts has been reduced, while that of the ocean currents has been slightly increased. Further, the distribution of ice is now shown.

R. DEC. WARD.

Southern Hemisphere Surface-Air Circulation: Being a study of the mean monthly pressure amplitudes, the tracks of the Anticyclones and Cyclones, and the Meteorological Records of several Antarctic expeditions. By William J. S. Lockyer. iii and 110 pp. Maps, diagrams, index. Solar Physics Observatory. Eyre & Spottiswoode, Ltd., London, 1910. 6s. 12 x 10.

This memoir represents an immense amount of labor. Its purpose was to study the mechanism of the atmospheric circulation of the southern hemisphere. Dr. Lockyer took the daily records of the barometric readings for the months of April to September for fifty-seven stations and made diagrams showing the rise and fall of the barometer. For many of the stations different years were taken into consideration; therefore the total number of curves drawn and investigated was 164.

In order to determine the mean amplitude of the recorded lows and highs, the three largest amplitudes on each curve were selected, the mean was formed

and then the variations—less than one-fifth of this mean amplitude—were disregarded in the counting. The mean amplitudes thus obtained show that the lines of equal-pressure amplitude form circles with the South Pole as center.

These pressure amplitudes increase in value from a minimum near the equator, rise to a maximum at 60° S., and then decrease to the South Pole. The amplitude is 4mm. along the parallel of 20° S., 13mm. at 40°, 19mm. at 60° and 16mm. at 70°.

The regions where directions along the parallels of latitude are conspicuously departed from are in South America and South Africa where high land exists. The paths of the equi-amplitude lines over the land surfaces correspond with the directions of the forward movement of the anticyclones over these lands. The increase in amplitude from the equator to about latitude 34° corresponds to the approach of the belt in which the anticyclones move; the maximum along the 60th parallel is due to the cyclonic belt, and the decrease farther south is due to the approach to the South Polar anticyclonic area.

Dr. Lockyer measured the mean daily rate of displacement of the anticyclones and found about 12° in longitude for South Africa, 11°5′ for South Australia, and 1°7′ for South America. Over the southern ocean the daily displacement of the anticyclones is about 9°2′ in longitude. The mean velocity around the earth being approximately 10°7′ per day, the anticyclones complete the circuit in about 33.6 days. A diagram (Pl. XIV) shows the correlation of the cyclones of the cyclonic belt with the anticyclones of the high-pressure area of the temperate region.

Comparing Dr. Lockyer's system of the surface-air circulation with what we know about atmospheric circulation in the northern hemisphere, one is tempted to think that his theory is simply a speculation. However, the daily weather maps of Australia and the experience gained by the antarctic expeditions in the frozen South show, in a most convincing fashion, that Dr. Lockyer's researches and the results he obtained are of a far-reaching practical value.

HENRYK ARCTOWSKI.

MATHEMATICAL GEOGRAPHY AND CARTOGRAPHY

The Effects of Errors in Surveying. By Henry Briggs. xi and 179 pp. Ills., index. C. Griffin & Co., Ltd., London, 1912. 8 x 5½.

This excellent little book, it is stated, is intended to investigate how errors combine in affecting the accuracy of surveys, in order that rules may be framed to help the surveyor to guard against error and methods devised to allow him to assess the error likely to occur in any given case in practice. After the introduction are five chapters headed, respectively, the analysis of error, the best shape of triangles, the propagation of error in traversing, the application of the methods of determining average error in traversing, and the propagation of error in minor triangulation. A final chapter summarizes the conclusions reached. The results of "Least Squares" are assumed, but the mathematical work involved in demonstrating the author's conclusions is given in full. The examples are such as occur in every-day practice with small instruments, rather than in geodetic work, thus making their application more general. The typography is excellent.

JAMES GORDON STEESE.

Lehrbuch der Landesvermessung. Von E. Hegemann. [Part 1]: 261 pp. Part 2: 306 pp. Map, diagrams. P. Parey, Berlin, 1906, 1913. Mk. 12. and Mk. 13. 9 x 6.

An unexplained interval of seven years separates the appearance of Vol. II, Projections, Levels, and Topography, from Vol. I, Triangulation, of this Manual of National Surveys. The treatment is essentially mathematical, about two-thirds of the work consisting of formulæ and their development. Wherever appropriate, illustrative examples from the Prussian Survey are solved in detail.

Chapter 1, Taking the Measurements, occupies half of the first volume. It discusses the field work and methods of a primary triangulation survey. Much of it is of historical interest only, being a description of the methods and instruments employed at different times on the Prussian Survey, rather